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**Kikuchi et al.**

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(54) **ELECTRONIC DEVICE**

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**H01H 5/30** (2006.01)

(52) **U.S. Cl.** ..... **200/406**; 200/516

(58) **Field of Classification Search** ..... 200/406,  
200/516, 520, 533-535, 551, 341

See application file for complete search history.

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(57) **ABSTRACT**

A switch-type electronic device adapted to be mounted on a circuit board is disclosed. A housing is made of an insulative material. The housing includes a first face adapted to oppose the circuit board and a second face intersecting with the first face and formed with a projection. A cover is made of a conductive material. The cover includes a first part covering a side of the housing opposite to the first face, at least one second part extending from the first part and opposing the second face, and a third part extending from each of the at least one second part and engaging with the projection. An operating member includes a first part disposed outside the housing and adapted to be operated by a user, and a second part disposed in the housing and configured to switch the electronic device between a first state and a second state when the first part is operated by the user. The first part of the operating member includes a portion opposing the second part of the cover, and is configured to abut against the second part of the cover when the electronic device is switched between the first state and the second state.

**6 Claims, 10 Drawing Sheets**

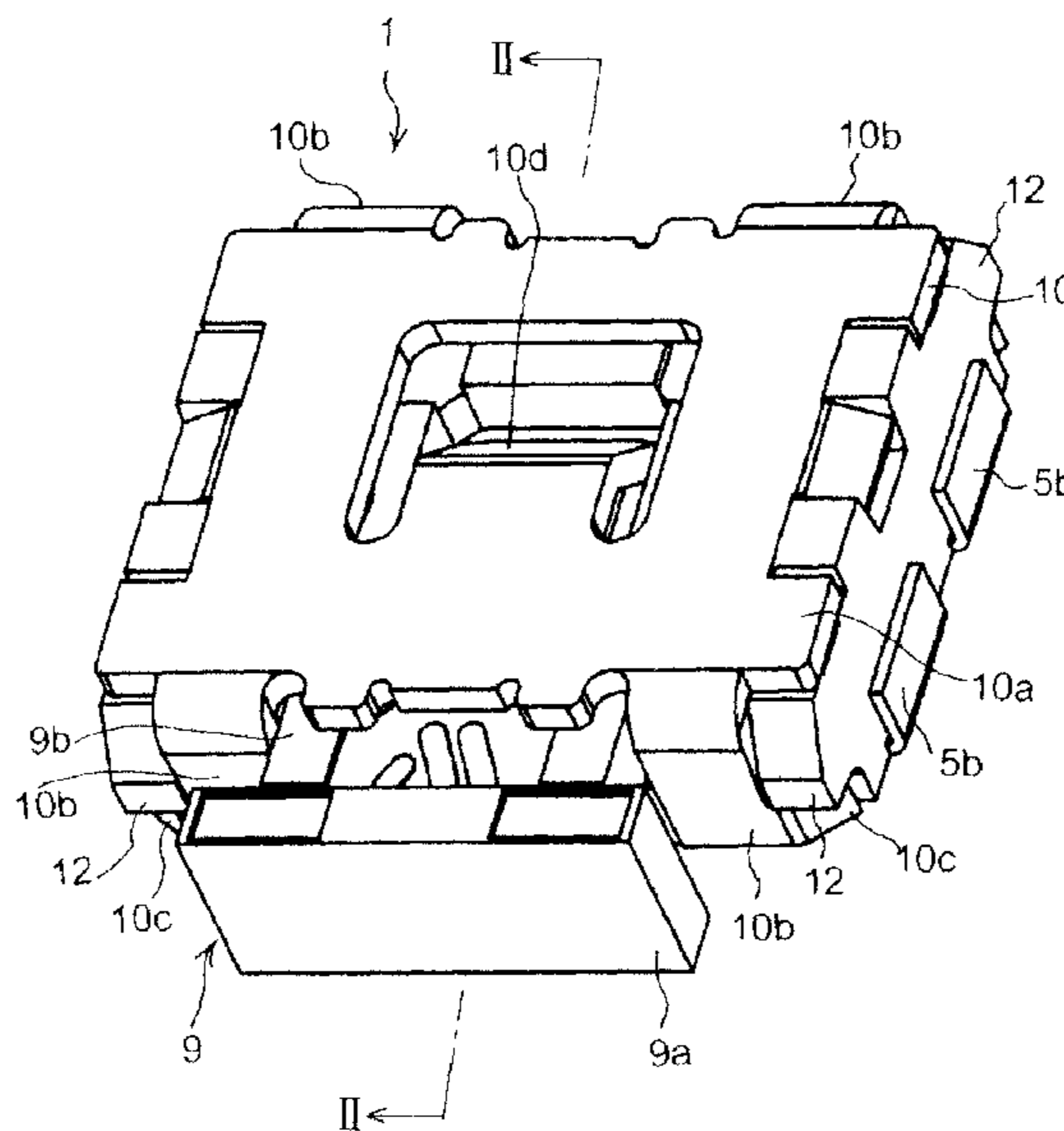


FIG. 1

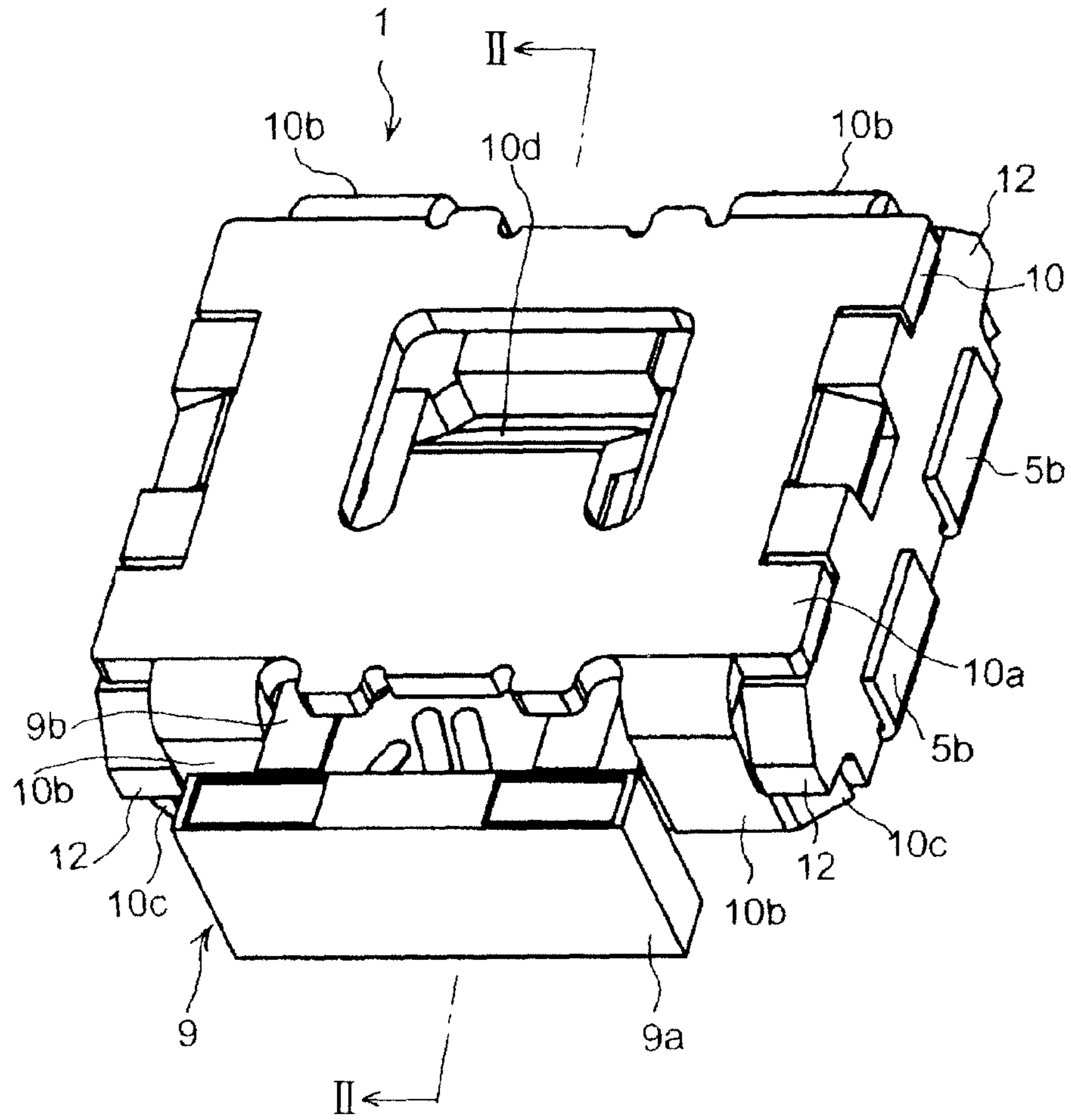


FIG. 2

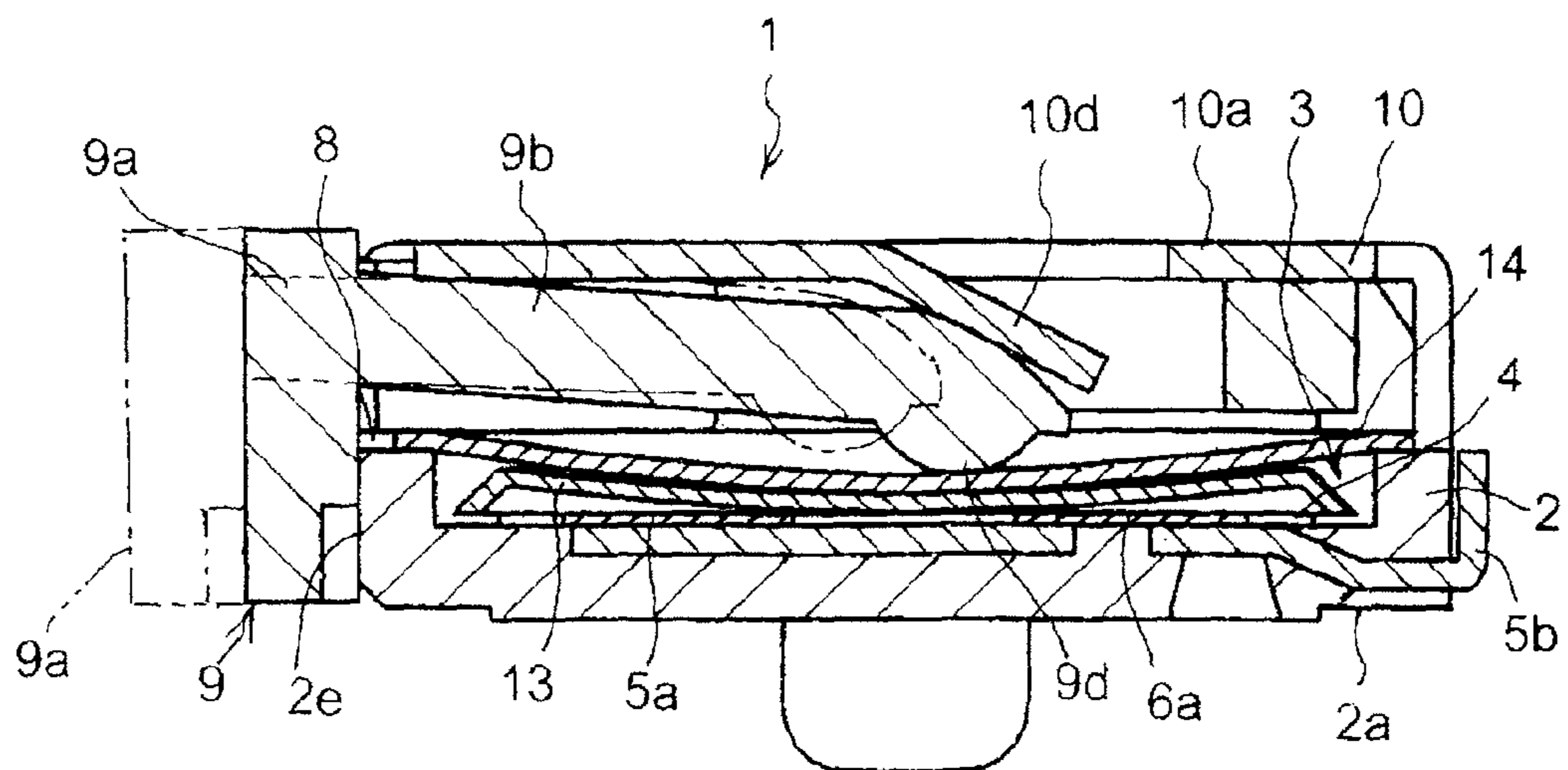


FIG. 3

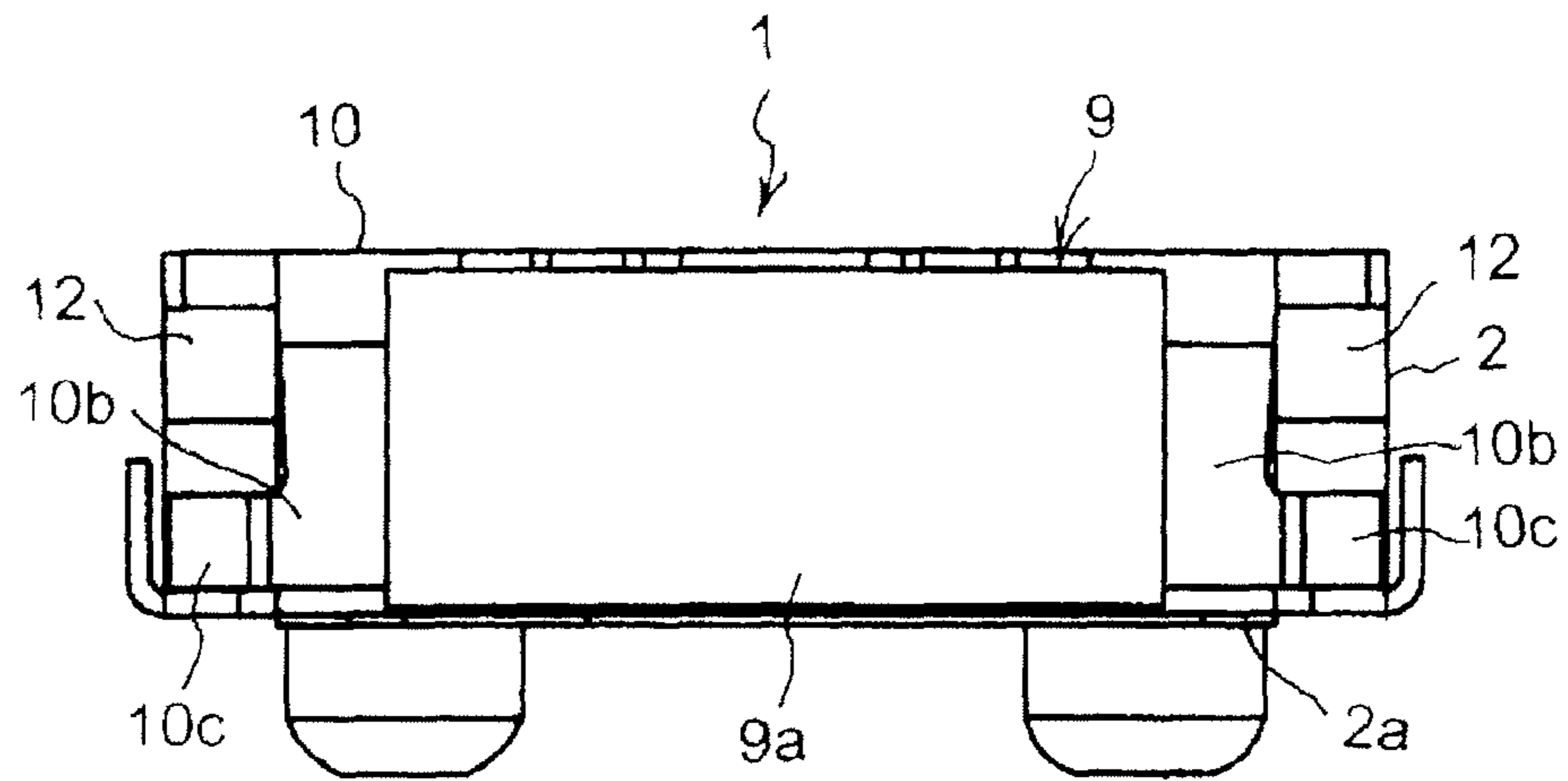


FIG. 4

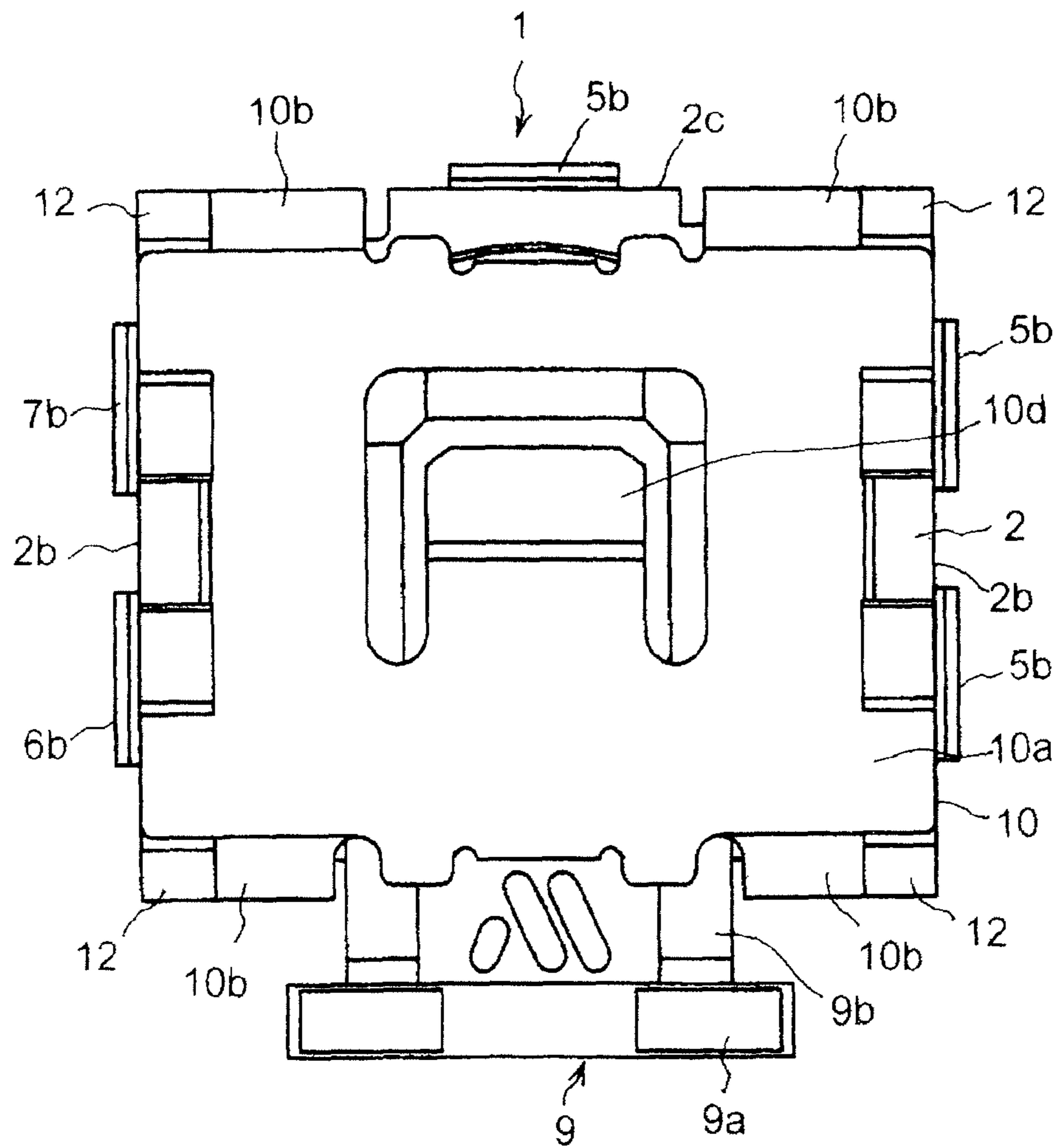


FIG. 5

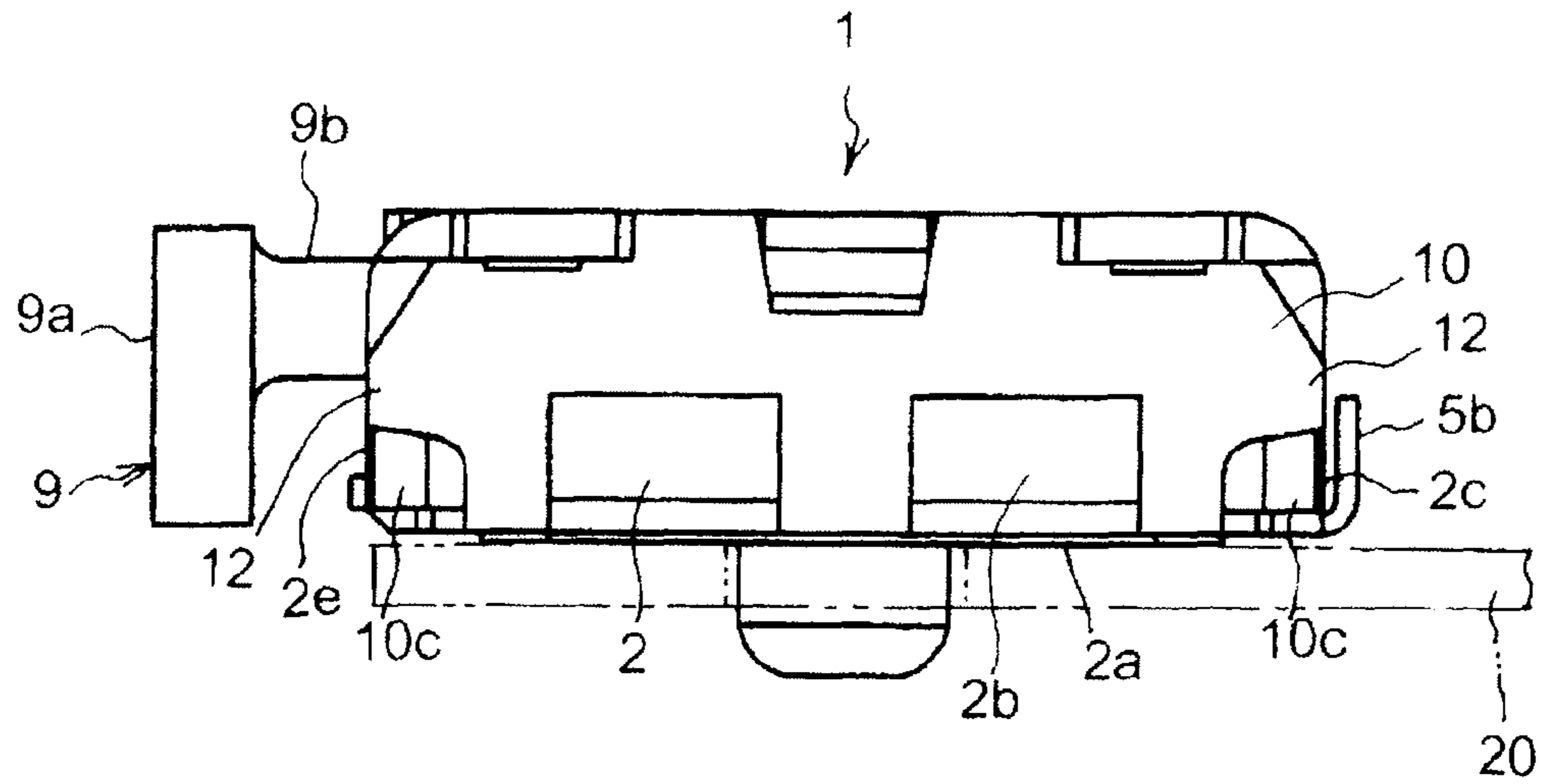


FIG. 6

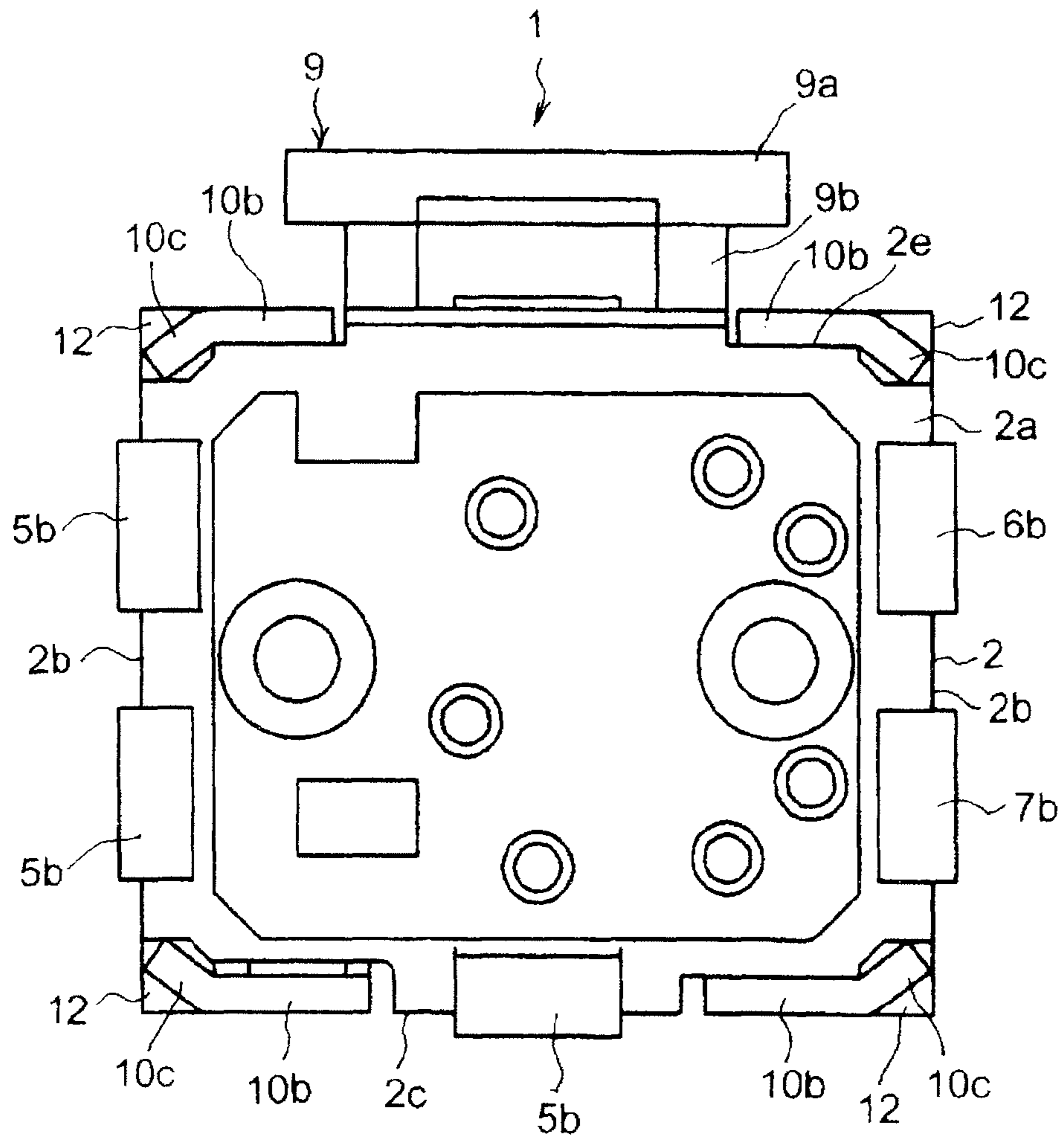


FIG. 7

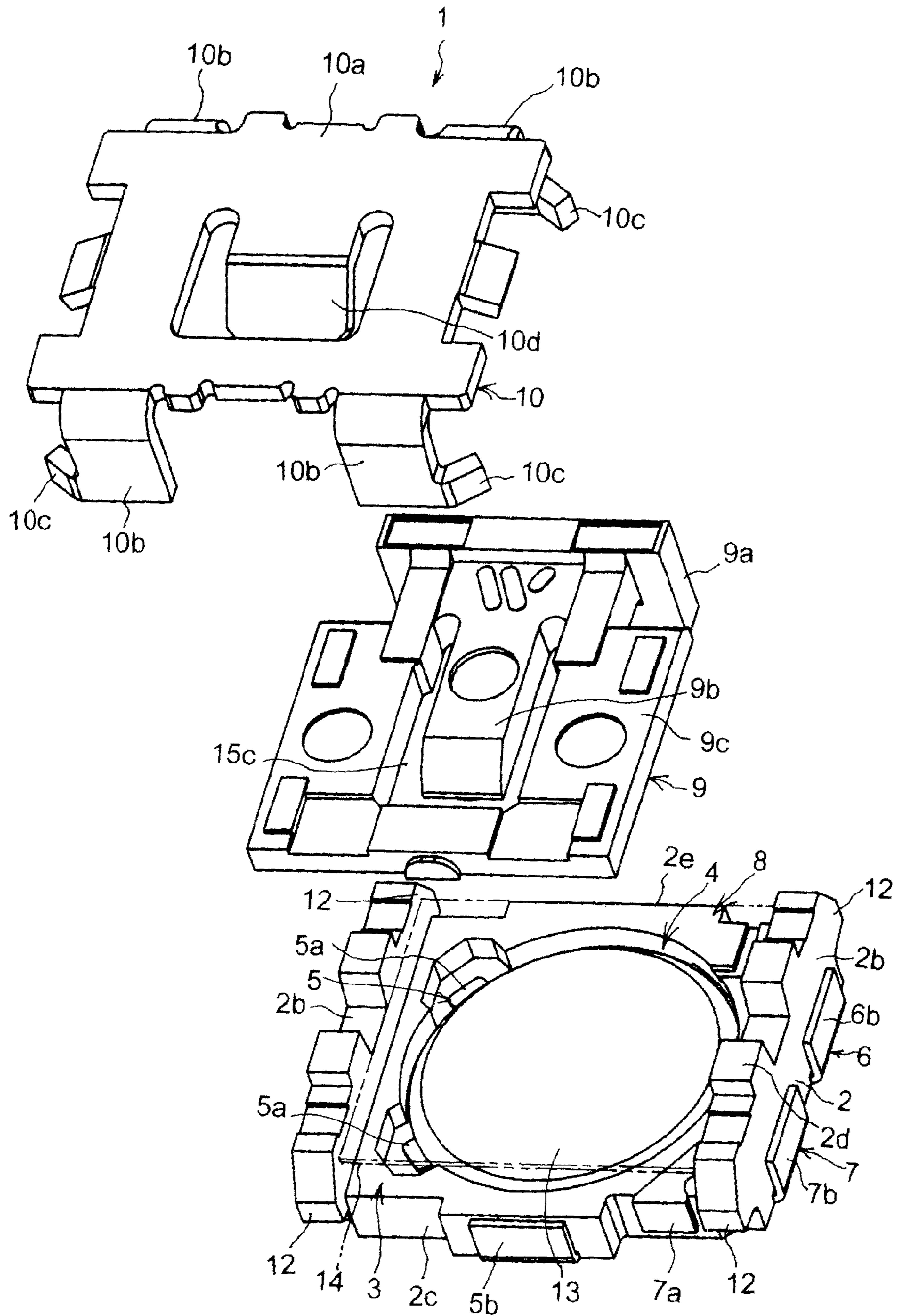


FIG. 8

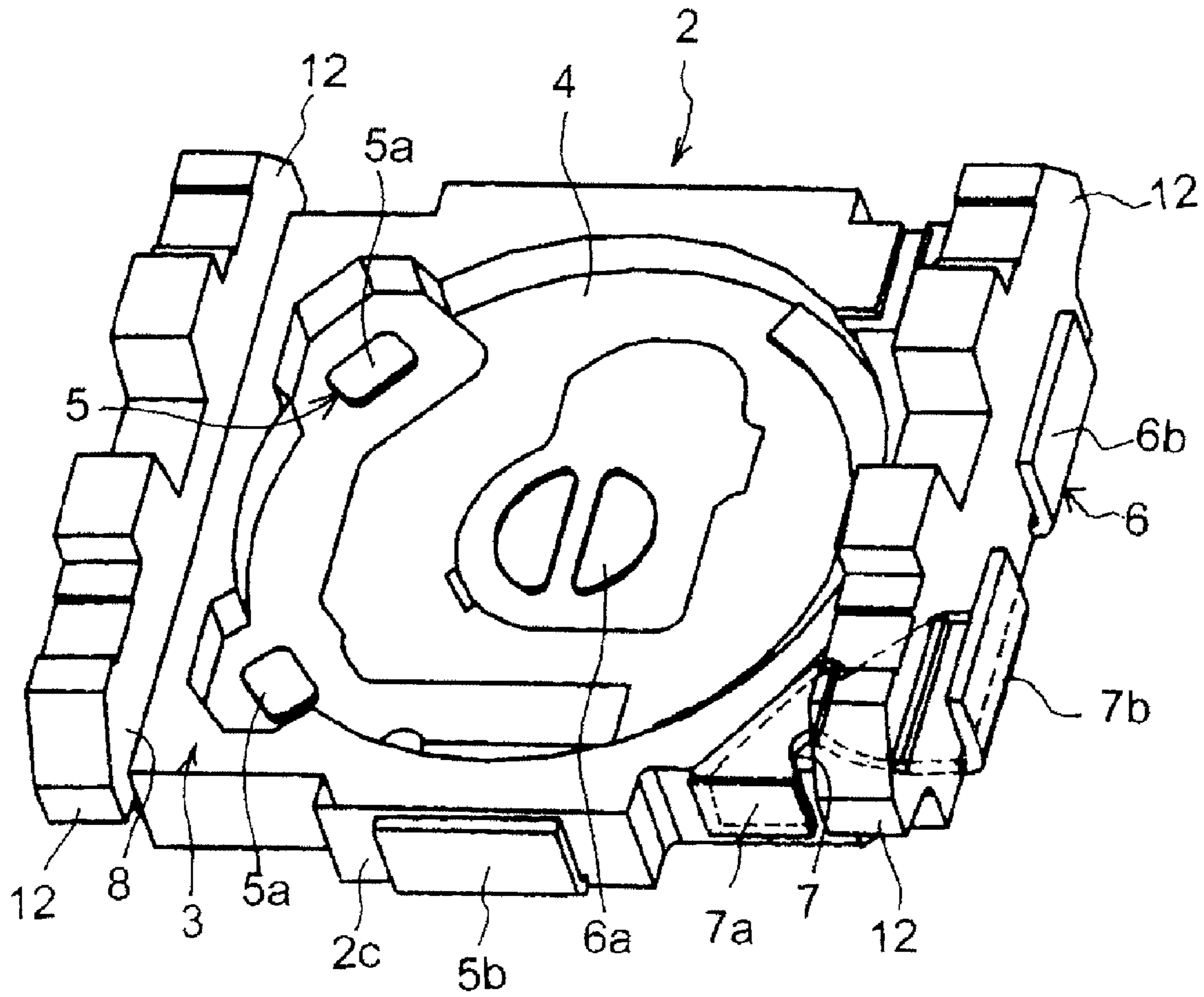
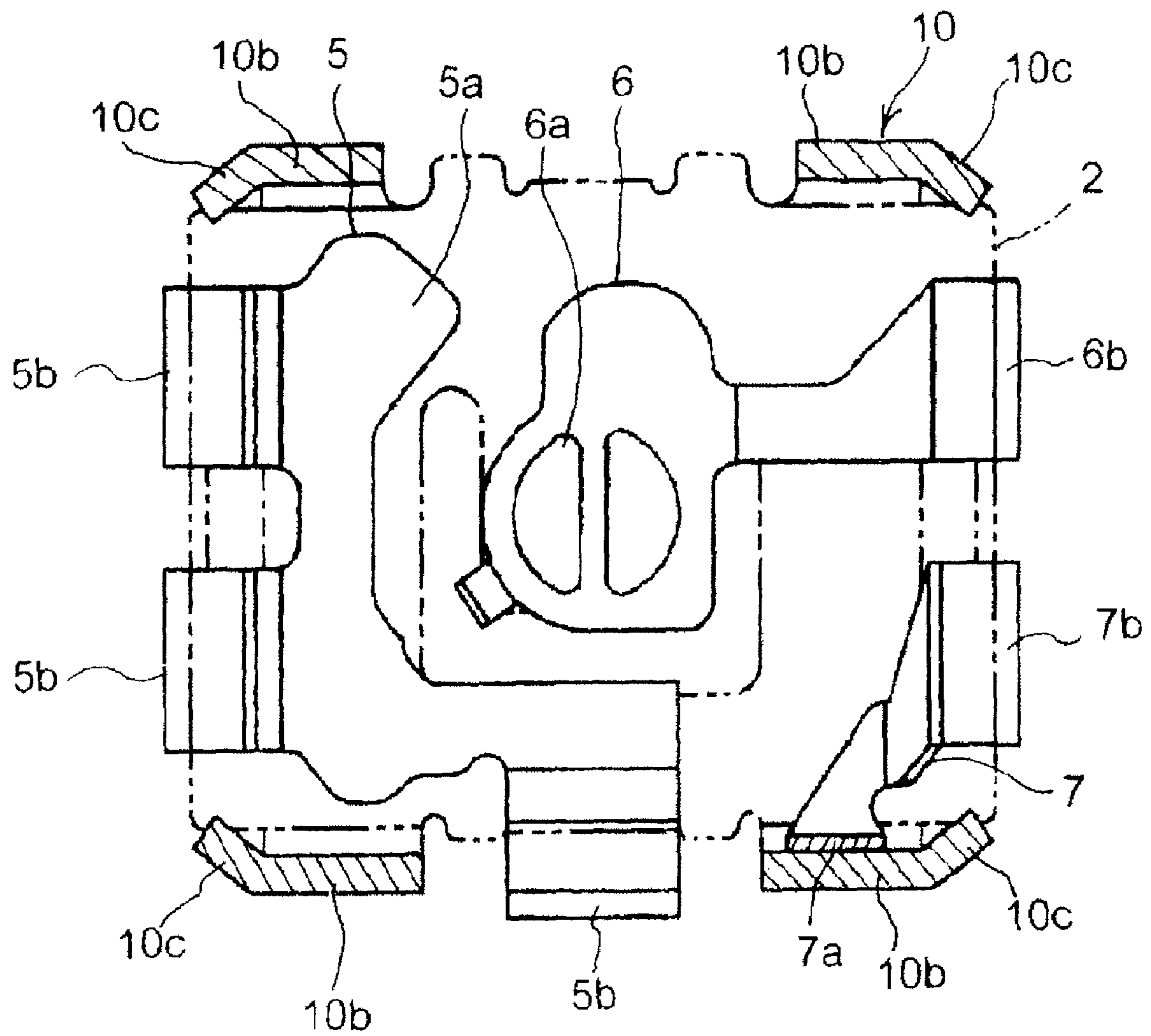


FIG. 9



*FIG. 10*

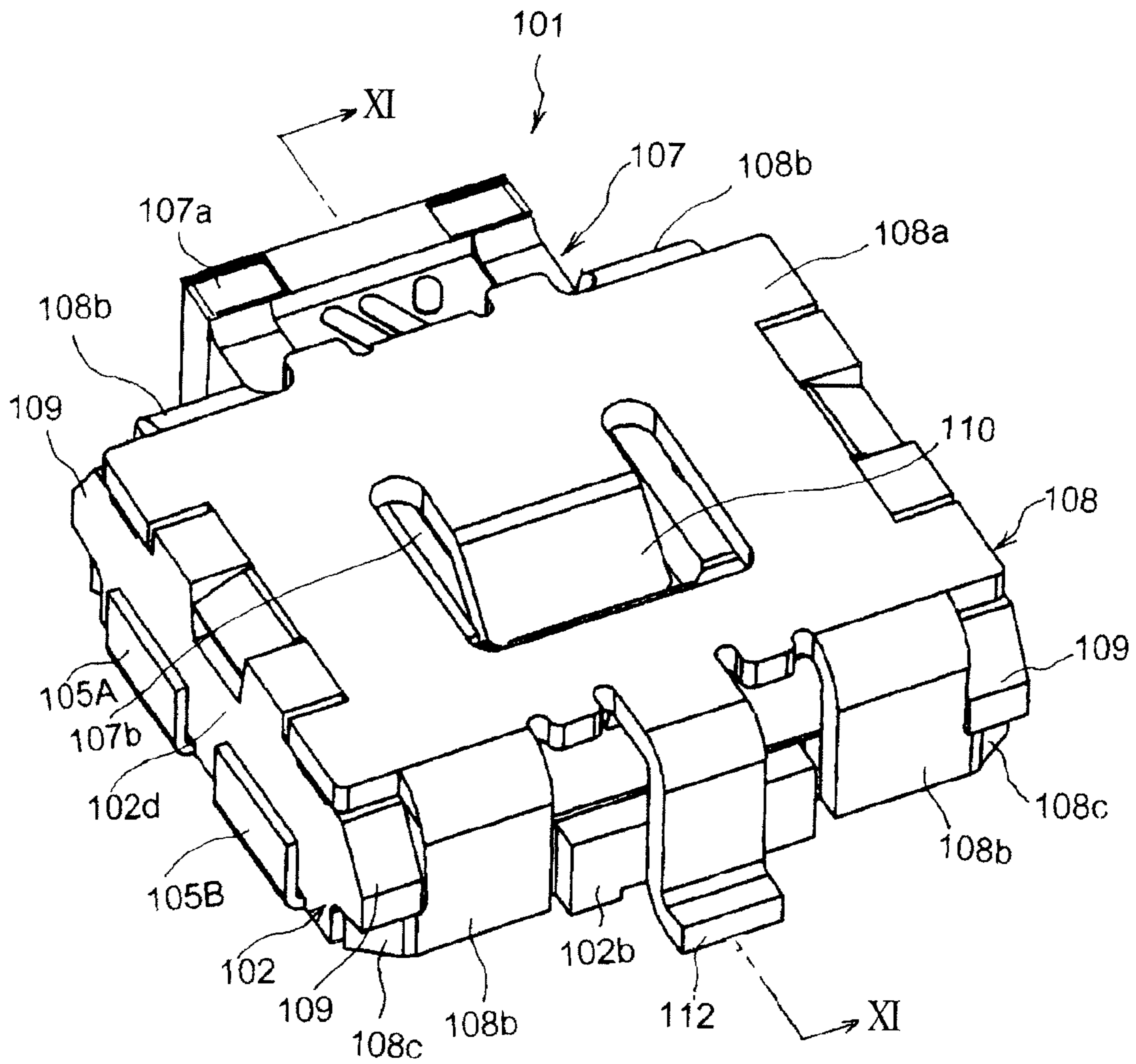




FIG. 11

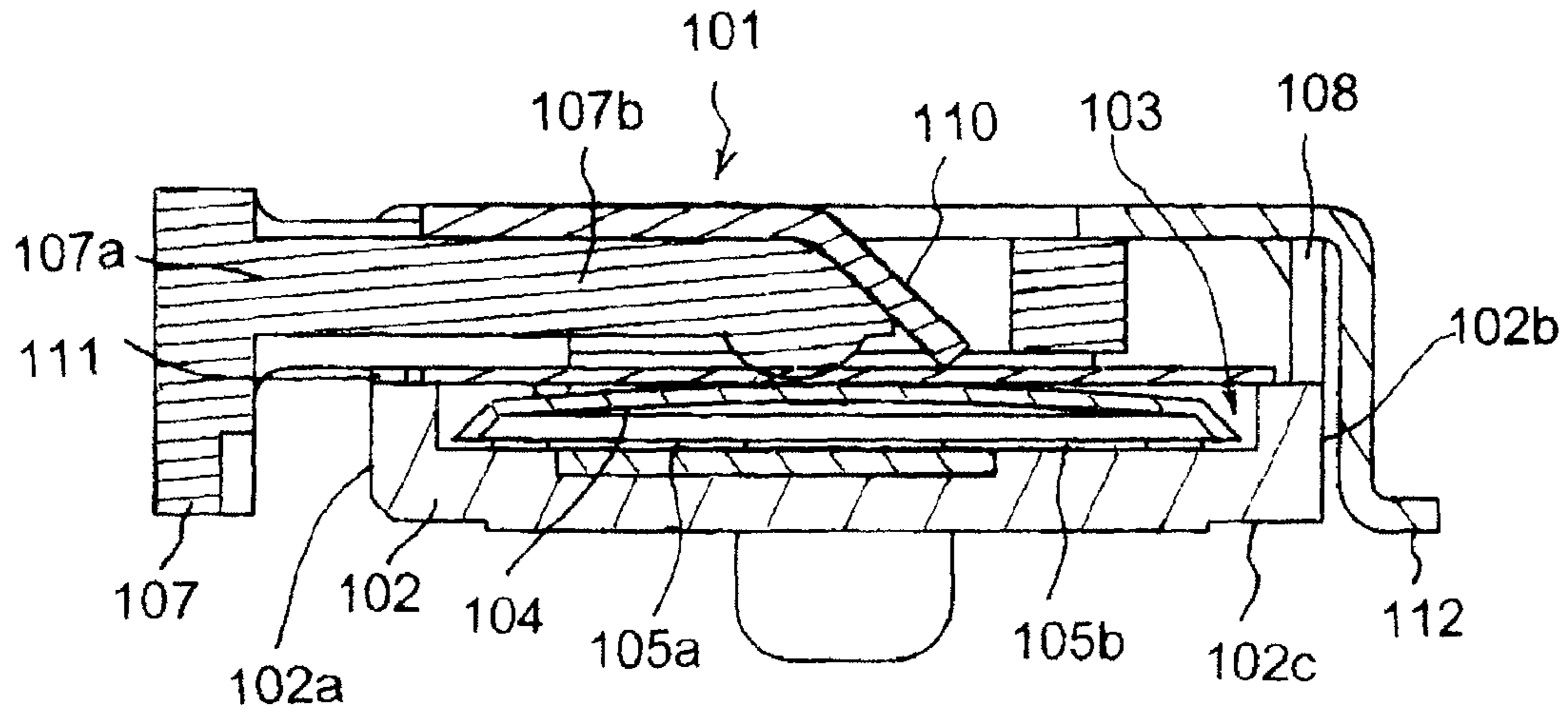


FIG. 12

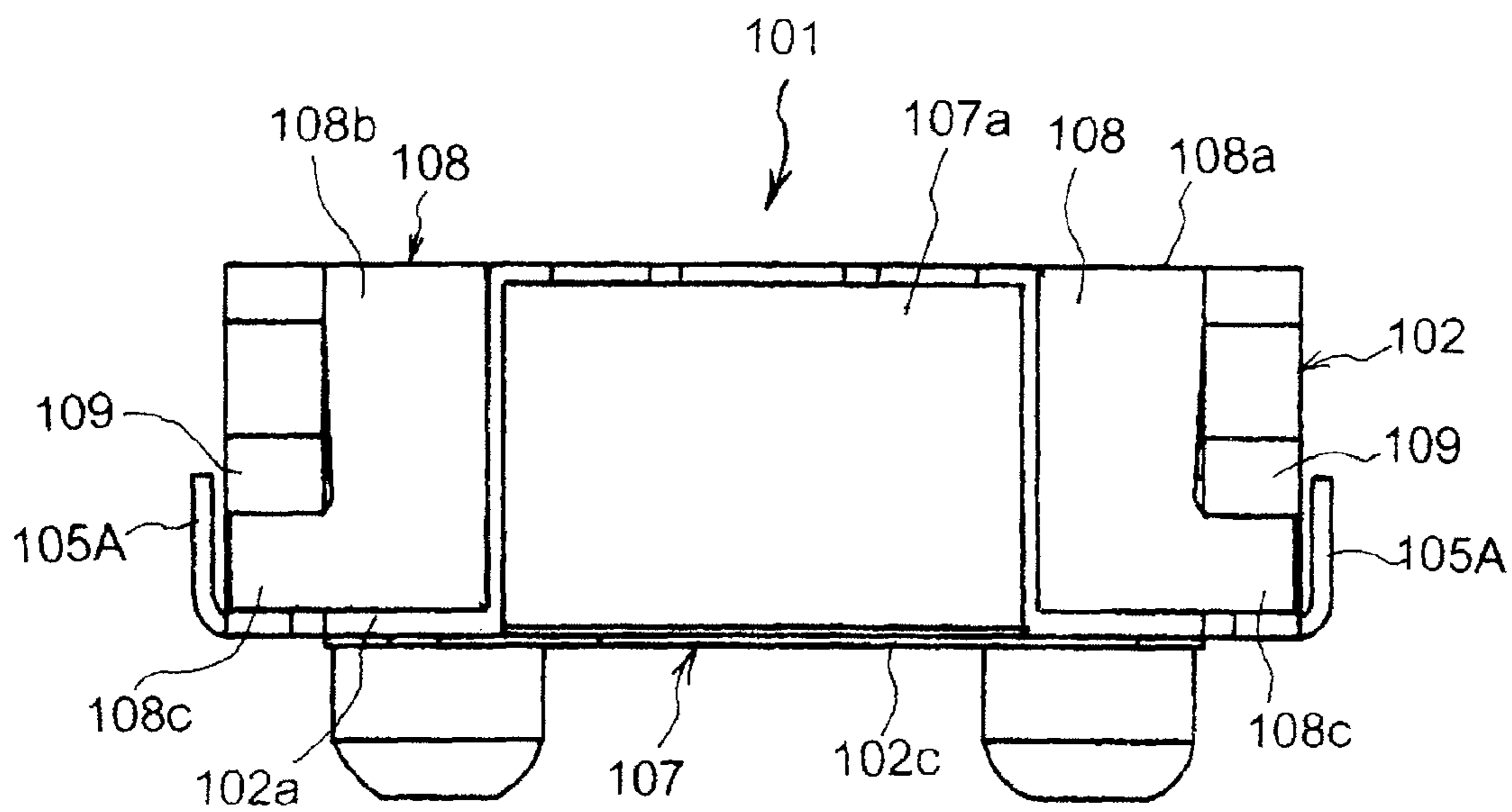


FIG. 13

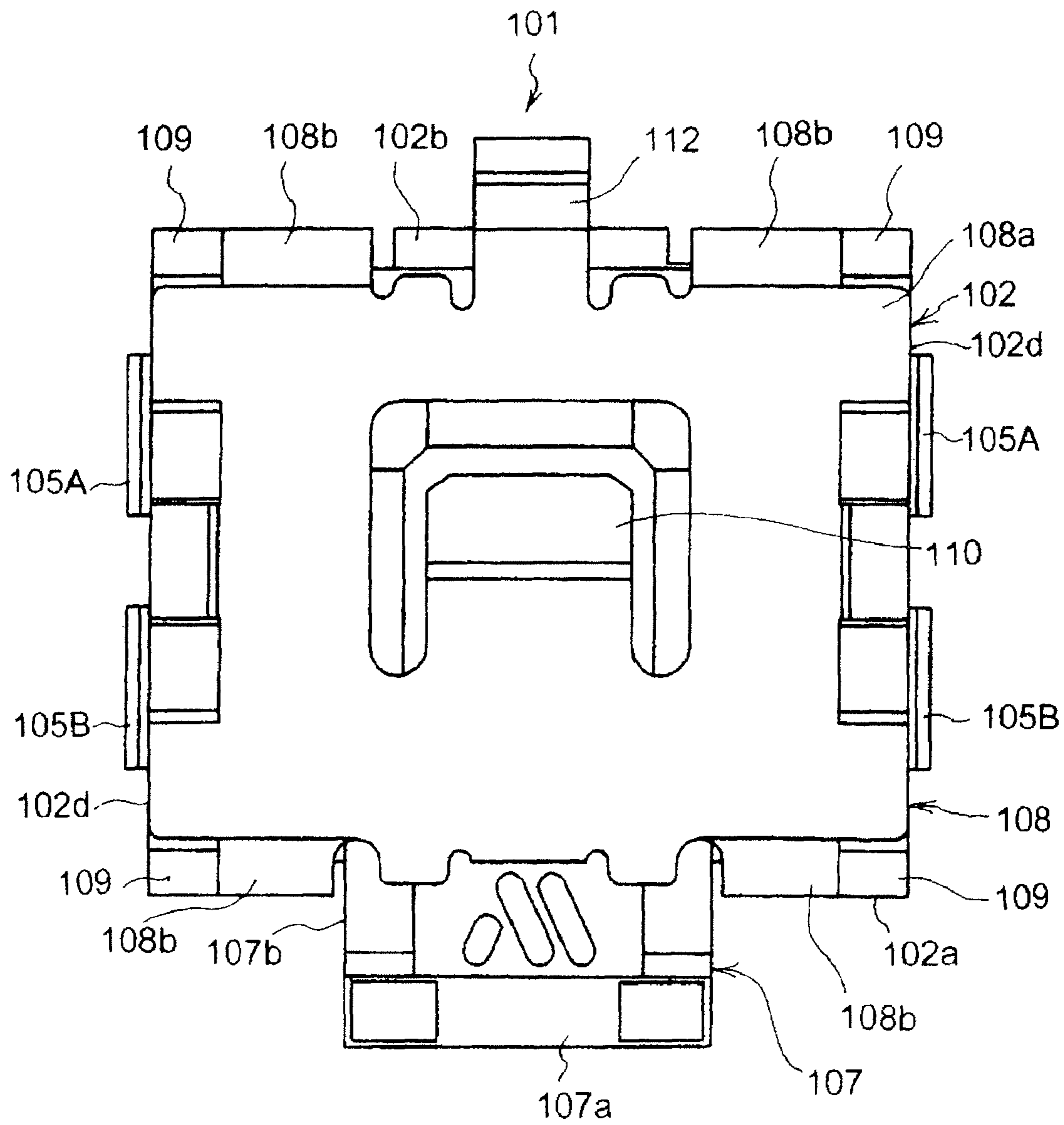
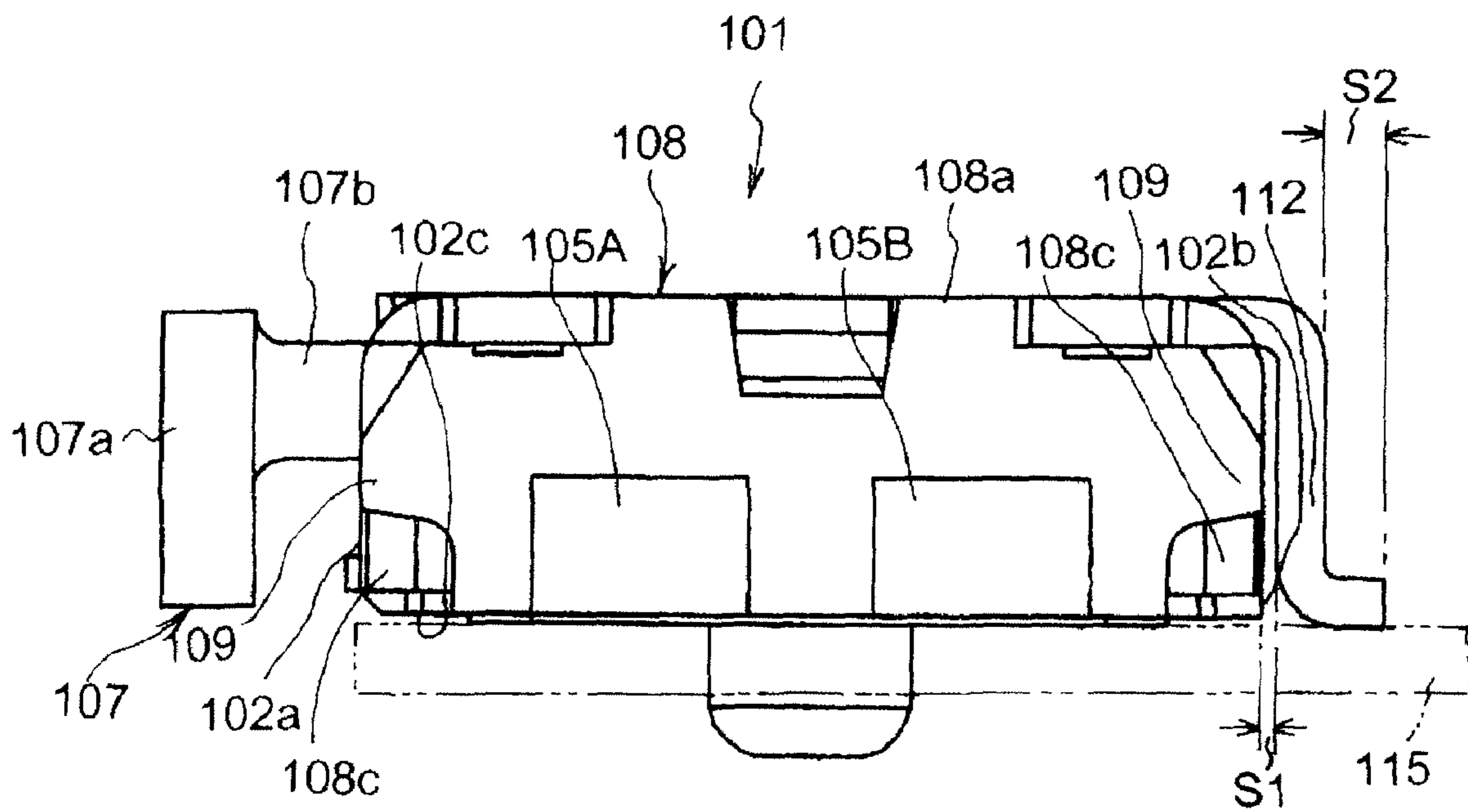


FIG. 14



## ELECTRONIC DEVICE

## BACKGROUND

The present invention relates to an electronic device including a switch-type electronic device such as a push switch adapted to be mounted on a printed circuit board to be disposed in various kinds of electronic apparatuses.

There are known various kinds of switch-type electronic devices such as a push switch mounted on a printed circuit board of an electronic apparatus (see, Japanese Patent Publication No. 9-120742 A).

As the conventional switch-type electronic device to which the countermeasure for the static electricity is applied, one example will be described by referring to FIGS. 10 to 14.

As shown in FIG. 11, a push switch 101 comprises a box-shaped housing 102 formed with a space 103 an upper side of which is opened. A circular dome-shaped movable contact 104 made of an elastic thin metal plate is disposed on an inner bottom part of the space 103. A central lower face of the movable contact 104 opposes fixed contacts 105a and 105b each of which is made of the thin metal plate and fixed on the housing 102 by insertion molding. A protective film 106 is disposed on an upper part of the movable contact 104, and an operating member 107 made of resin is disposed on the protective film 106. A cover 108 made of metal is attached to the housing 102 so as to cover the operating member 107 from above.

The housing 102 includes engaging projections 109 respectively protruding outward along a lower face 102c of the housing 102 at right and left corners of front and rear side faces 102a and 102b of the housing 102. Further, in the other end sides, lead terminals 105A and 105B are provided that are directed outward the right and left side faces 102d and 102d of the housing 102 from the lower face 102c.

The operating member 107 includes a pressed part 107a and an elastic actuator 107b. The pressed part 107a extends from a front side face 102a of the housing 102 through an opening 111 formed in the front side face 102a.

The cover 108 is located on an upper face of the housing 102. The cover 108 includes an upper plate 108a having an inclined piece obliquely extended from a center part thereof toward the inside of the space 103. A pair of legs 108a are extended downward from a front edge of the upper plate 108a along the front side face 102a of the housing 102. A pair of legs 108b are extended downward from a rear edge of the upper plate 108a along a rear side face 102b. At a lower end of each of the legs 108b, an engagement piece 108c is formed so as to oppose a lower face of an associated one of the engagement projections 109. The engagement pieces 108c are bent and caulked so that the cover 108 is retained on the housing 102.

The pair of right and left legs 108b provided in the front side face 102a of the housing 102 are separated from each other sufficiently so that at least the operating member 107b of the operating member 107 can be translated therebetween.

In the push switch 101 mounted on the printed circuit board 115 in such a way, under a state that the operating member 107 is arranged at a position shown by a dashed chain line in FIG. 11, when a front end of the pressed part 107a is horizontally pressed rearward, the operating member 107 horizontally moves on the protecting film 106 along the upper face of the housing 102 and the end of the operating member 107b is directed downward by the inclined piece 110 to apply a push down force to the movable contact 104 located at a lower part.

When the push down force exceeds a prescribed level, as shown by a solid line of FIG. 11, the lower face of the central part of the movable contact 104 moves downward and comes into contact with the fixed contacts 105a and 105b to obtain a conductive state (turn-on state) in which the lead terminals 105A and 105B are short-circuited through the movable contact 104. As an amount of pushing operation of the operating member 107, when the rear face of the pressed part 107a abuts against the front side face 102a of the housing 102, a further pushing operation is regulated.

When the operating force of the pressed part 107a is released, the movable contact 104 is self-restored to an original attitude to push up the operating member 107b and the end of the operating member 107b is guided by the inclined piece 110, so that the operating member 107 is pushed back forward to the position shown by the dashed chain line in FIG. 11 to return to an original non-conductive state (turn-off state).

However, the above-described conventional push switch has a structure that the operating member 107 is continued to be pressed from outside the front side face 102a of the housing 102 until the operating member 107 abuts against the front side face 102a of the housing 102. The forces acting on the respective members during in the above pushing operation will be described with reference to FIG. 13. When the operating member 107 is pushed with a force (a pressing force) P, a pushing up force gradually acts on the cover 108 as the pushing operation proceeds. This force acts on the legs 108b as a force (a reaction force) f for pushing the legs 108b outward. In such a case, there is a probability that the legs 108b and the cover 108 would be deformed to damage a function of the switch.

In these days, downsizing of such a push switch is strongly demanded. The width of each side face of the housing 112 is required to be no greater than 3 mm, and the thickness of the cover 108 is required to be no greater than 0.2 mm. In such a size, the above-described deformation becomes remarkable.

As a countermeasure for preventing the deformation, the thickness or the size of the cover 108 or the width of the leg 108b may be increased to ensure the strength of parts. However, contrary to the above-described demand, the size of the push switch is increased.

## SUMMARY

It is therefore one advantageous aspect of the present invention to provide an electronic device capable of preventing a cover from being deformed during a pushing operation of an operating member without increasing the size of the electric device.

According to one aspect of the invention, there is provided a switch-type electronic device adapted to be mounted on a circuit board, comprising:

- a housing, having:
  - a first face, adapted to oppose the circuit board; and
  - a second face, intersecting with the first face and formed with a projection;
- a cover, having:
  - a first part, covering a side of the housing opposite to the first face;
  - at least one second part, extending from the first part and opposing the second face; and
  - a third part, extending from each of the at least one second part and engaging with the projection; and
- an operating member, having a first part disposed outside the housing and adapted to be operated by a user, and a second part disposed in the housing and configured to switch the

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electronic device between a first state and a second state when the first part is operated by the user, wherein:

the first part of the operating member has a portion opposing the second part of the cover, and is configured to abut against the second part of the cover when the electronic device is switched between the first state and the second state.

The switch-type electronic device may be configured such that: the at least one second part includes a pair of second parts; and the second part of the operating member is located between the pair of second parts.

The switch-type electronic device may be configured such that: a thickness of the cover is no greater than 0.2 mm.

According to one aspect of the invention, there is provided a push switch adapted to be mounted on a circuit board, comprising:

a housing, having:  
a first face, adapted to oppose the circuit board; and  
a second face, intersecting with the first face and formed with a projection;  
a cover, having:  
a first part, covering a side of the housing opposite to the first face;

at least one second part, extending from the first part and opposing the second face; and

a third part, extending from each of the at least one second part and engaging with the projection;

an operating member, having a first part disposed outside the housing and adapted to be operated by a user, and a second part disposed in the housing;

a movable contact, disposed in the housing and configured to be actuated by the second part of the operating member when the first part of the operating member is operated by the user; and

fixed contacts, disposed in the housing and configured to be electrically connected with each other by way of the movable contact when the movable contact is actuated by the second part of the operating member,

wherein the first part of the operating member has a portion opposing the second part of the cover, and is configured to abut against the second part of the cover when the fixed contacts are electrically connected with each other.

The push switch may be configured such that: the at least one second part includes a pair of second parts; and the second part of the operating member is located between the pair of second parts.

The push switch may be configured such that: a thickness of the cover is no greater than 0.2 mm.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a push switch according to one embodiment of the present invention.

FIG. 2 is a sectional view taken along a line II-II in FIG. 1 and showing a state that an operating member is pushed in.

FIG. 3 is a front view of the push switch.

FIG. 4 is a plan view of the push switch.

FIG. 5 is a side view of the push switch.

FIG. 6 is a bottom view of the push switch.

FIG. 7 is a perspective view of the push switch in a disassembled condition.

FIG. 8 is a perspective view showing a housing of the push switch.

FIG. 9 is a schematic view showing an arrangement of contact members and a cover of the push switch.

FIG. 10 is a perspective view of a conventional push switch.

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FIG. 11 is a sectional view taken along a line XI-XI of FIG. 10.

FIG. 12 is a front view of the conventional push switch.

FIG. 13 is a plan view of the conventional push switch.

FIG. 14 is a side view of the conventional push switch.

#### DETAILED DESCRIPTION OF EXEMPLIFIED EMBODIMENTS

Exemplified embodiments of the invention are described below in detail with reference to the accompanying drawings.

As shown in FIGS. 1 to 9, a push switch 1 which is one example of a switch-type electronic device comprises a box-shaped housing 2 made of a resin material and formed with space 3 an upper side of which is opened shown in FIGS. 2, 7 and 8. A pair of first contact members 5 and 6 and a second contact member 7 are integrally embedded by an insert molding in an inner bottom part 4 of the space 3. The pair of first contact members 5 and 6 are made of a metal plate. The second contact member 7 is made of a metal plate. As well as the conventional push switch, the width of each side face of the housing 2 is no greater than 3 mm.

As shown in FIGS. 2, 7 and 8, a fixed contact 5a is provided on one end of the first contact member 5 and exposed at the inner bottom face 4 of the space 3. A lead terminal 5b is provided on the other end of the first contact member 5 and led out from a lower face 2a of the housing 2 so as to extend outward of one of opposite side faces 2b of the housing 2. A fixed contact 6a is provided on one end of the first contact member 6 and exposed at the inner bottom face 4 of the space 3. A lead terminal 6b is provided on the other end of the first contact member 6 and led out from the lower face 2a so as to extend outward of the other one of the opposite side faces 2b of the housing 2. The first contact member 5 is provided with further lead terminals 5b which are led out from the lower face 2a so as to extend outward of the rear side face 2c of the housing 2.

An external fixed terminal 7a is provided on one end of the second contact member 7 and exposed at a position on the rear side face 2c closer to one of the opposite side faces 2b (in FIGS. 7 to 9, the right side face) so as to extend downward from an upper face 2d of the housing 2 toward the lower face 2a. A lead terminal 7b is provided on the other end of the second contact member 7 and led out from the lower face 2a so as to extend outward of the one of the opposite side face 2b on which the lead terminal 6b is disposed.

A front side face 2e of the housing 2 is formed with an opening 8 communicating with the space 3. An operating member 9 includes a pressed part 9a and an actuator 9b (described later in detail). The operating member 9 is accommodated in the space 3 such that the pressed part 9a and a part of the actuator 9b extend outward through the opening 8. At both side end portions of each of the rear side face 2c and the front side face 2e, there are provided engagement projections 12 to which engagement pieces 10c of legs 10b provided on a cover 10 (described later in detail) are engaged by caulking.

A dome-shaped movable contact 13 made of a thin metal plate is disposed on above fixed contacts 5a and 6a. A lower face of a top portion of the dome-shaped movable contact 13 opposes the fixed contact 6a across a gap therebetween. An outer peripheral portion of the dome-shaped movable contact 13 is in contact with the fixed contact 5a.

A protecting sheet 14 made of an insulating resin sheet material such as polyamide resin is disposed above the movable contact 13. The peripheral edge part of the protecting sheet 14 is mounted on the upper face of the housing 2 and fixed by adhesive agent so as to cover the space 3 therewith to

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prevent dust or foreign materials from entering the conductive members disposed in the space 3.

As shown in FIG. 7, the operating member 9 is made of a resin and includes: the pressed part 9a which is always to be located outside the housing 2; the actuator 9b extended from the pressed part 9a toward inside the space 3; a slider 9c surrounding the actuator 9b across a gap 15c therebetween. The pressed part 9a has parts extended from a front end of the actuator 9b upward, downward, rightward and leftward.

The pressed part 9a serves as a face receiving an operation for pushing the operating member 9 from the outside of the housing 2. Further, the pressed part 9a serves to prevent the legs 10b of the cover 10 located both sides of the opening 8 from being deformed forward. A lateral width of the pressed part 9a is, as shown in FIG. 3, sufficiently greater than a width of each of the legs 10b. When the operating member 9 is pushed into the space 3 in the housing 2 and the turn-on state is established (described later in detail), a rear face of the pressed part 9a comes in contact with the legs 10b so that the pressed part 9a covers at least parts of the legs 10b, thereby preventing the legs 10b from being deformed forward. Alternatively, the rear face of the pressed part 9a may come in contact with the front side face 2e and may oppose the legs 2b across minute gaps therebetween.

The operating member 9 is disposed above the protective sheet 14 so that an abutment part 9d which is a free end of the actuator 9b opposes an upper face of the top part of the dome-shaped movable contact 13 across the protective sheet 14. The slider 9c is slidably disposed within the space 3.

The cover 10 is formed by punching and bending a metal plate. The cover 10 includes: a flat upper plate 10a attached to an upper part of the housing 2 so as to cover the space 3; and four legs 10b extended from both side portions of each of a front edge and a rear edge of the upper plate 10a and bent downward. The engagement piece 10c is provided on a tip end of each leg 10b. The engagement pieces 10c are caulked so as to engage with the lower faces of the engagement projections 12 to retain the cover 10 on the housing 2. As well as the conventional push switch, the thickness of the cover 10 is no greater than 0.2 mm.

When the cover 10 is attached to the upper part of the housing 2, one of the legs 10b attached on the rear side face 2c of the housing 2 comes in contact with the external fixed terminal 7a of the second contact member 7 so as to establish electric connection. The contact between the external fixed terminal 7a and the leg 10b is firmly retained by bending the engagement piece 10c of the leg 10b toward the housing 2 and caulking to engage with the engagement projection 12.

An inclined part 10d is formed by bending a substantial center part of the upper part of the upper plate 10a toward the inside of the space 3 of the housing 2 by about 45 degrees. The inclined part 10d is so configured as to abut against the abutment part 9d of the actuator 9b to bias the actuator 9b in a direction pressing the movable contact 13. When the cover 10 is attached to the upper part of the housing 2, the inclined part 10d is located within the gap 15. When the pressed part 9a is laterally (from front side) pressed, the abutment part 9d of the actuator 9b comes in contact with the inclined part 10d so that the abutment part 9d is guided in a direction that the movable contact 13 is pressed (downward perpendicular to the direction that the part 9a is pressed). Accordingly, the movable contact 13 is pressed downward and comes in contact with the fixed contacts 5a and 6a.

In order to assemble the push switch 1, the movable contact 13, the protective sheet 14 and the operating member 9 are housed within the space 3 of the housing 2 in this order. Then, the cover 10 is attached to the upper part of the housing 2.

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After that, the engagement pieces 10c of the legs 10b are respectively caulked to engage with the lower faces of the engagement projections 12.

When the push switch 1 is mounted on the printed circuit board 20, as shown in FIG. 5, the operating member 9 is projected forward from the printed circuit board 20, and the lead terminals 5b, 6b and 7b are soldered with associated wiring parts. In this condition, the second contact member 7 is connected to a wiring part of the earth circuit on the printed circuit board 20 by way of the lead terminal 7b. Also the cover 10 is connected to the wiring part of the earth circuit by way of the second contact member 7.

There will be described how to operate the above-described push switch 1 with reference to FIG. 2.

First, under an initial condition shown by dashed chain lines, the abutment part 9d of the operating member 9b is in contact with the upper face of the top part of the dome-shaped movable contact 13 across the protecting sheet 14. In accordance with a synergism of elastic urging force of the movable contact 13 directed upward and the inclined face of the inclined part 10d, the operating member 9 is urged leftward in this figure (in an opposite direction to the direction that the pressed part 9a is pressed), thereby the pressed part 9a is projected outward (forward) from the housing 2. Incidentally, the outer peripheral portion of the movable contact 13 is in contact with the fixed contact 5a but the lower face of the top part of the dome-shaped movable contact 13 is away from the fixed terminal 6a, so that the push switch 1 is placed in the turn-off state.

From this state, when the pressed part 9a is pressed rightward in this figure, the abutment part 9d of the operating member 9b is guided downward (perpendicular to the direction that the pressed part 9a is pressed) along the inclined part 10d of the cover 10, and presses the upper face of the top part of the dome-shaped movable contact 13 through the protecting sheet 14. Accordingly, the movable contact 13 is moved downward and the lower face of the top part thereof comes into contact with the fixed contact 6a. As a result, the fixed contacts 5a and 6a are electrically connected, and the push switch 1 is placed in the turn-on state.

When the operating member 9 is pushed into the space 3 of the housing 2 and the fixed contacts 5a and 6a are electrically connected, the rear face of the pressed part 9a comes in contact with the legs 10b and the pressed part 9a covers at least parts of the legs 10b in order to prevent the legs 10b from being deformed forward thereby the engagement pieces 10c are disengaged from the engagement projections 12. With this configuration, the strength of the cover 10 can be eventually increased without increasing the width and thickness of the cover 10 and the legs 10b. As a result, downsizing of the push switch can be attained.

The rear face of the pressed part 9a may not come in contact with the legs 10b but may be configured to be stopped at such a position that the rear face of the pressed part 9a opposes the legs 10b across such a minute gap that the deformed legs 10b immediately comes in contact with the rear face.

From the state, when the pressing against the pressed part 9a is canceled, the movable contact 13 moves upward due to the own elastic restoration force and the push switch 1 is placed in the turn-off state. In accordance with the urging force generated by the restoring action, the abutment part 9d of the actuator 9b is guided leftward in this figure (the opposite direction to the direction that the pressed part 9a is pressed) along the inclined part 10d, so that the pressed part 9a moves forward and returns to the original condition.

When the finger of a person who operates the push switch 1 mounted on the printed circuit board 20 installed in an

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electric apparatus pushes a front face of the pressed part **9a**, static electricity carried by the person may be of the operator is supplied to the operating member **9** through the finger. However, the supplied static electricity is transferred to the earth circuit on the printed circuit board **20** by way of the cover **10** and the second contact member **7**.

It is to be noted that although the above described embodiment is a preferable embodiment of the invention, the invention is not limited to this embodiment, but various modifications can be made within a scope not deviating from a gist of the invention.

The present invention is applicable to a switch-type electronic device other than the push switch and an electronic device other than the switch-type electronic device as long as it is adapted to be mounted on a circuit board by soldering.

The material of the housing **2** is not limited to resin as long as it is insulative. The material of cover **10**, the first contact members **5**, **6** and the second contact member **7** is not limited to metal as long as they are conductive.

The lead terminal **7b** may not be exposed at one of the opposite side face **2b** but may be exposed at the front side face **2e**.

What is claimed is:

1. A switch-type electronic device adapted to be mounted on a circuit board, comprising:
  - a housing, having:
    - a first face, adapted to oppose the circuit board; and
    - a second face, intersecting with the first face and formed with a projection;
  - a cover, having:
    - a first part, covering a side of the housing opposite to the first face;
    - at least one second part, extending from the first part and opposing the second face; and
    - a third part, extending from each of the at least one second part and engaging with the projection; and
  - an operating member, having a first part disposed outside the housing and adapted to be operated by a user, and a second part disposed in the housing and configured to switch the electronic device between a first state and a second state when the first part is operated by the user, wherein:
    - the first part of the operating member has a portion opposing the second part of the cover, and is configured to abut against the second part of the cover so as to prevent the second part of the cover being deformed outward when the electronic device is switched between the first state and the second state.

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2. The switch-type electronic device as set forth in claim 1, wherein:

- the at least one second part includes a pair of second parts; and

- the second part of the operating member is located between the pair of second parts.

3. The switch-type electronic device as set forth in claim 1, wherein:

- a thickness of the cover is no greater than 0.2 mm.

4. A push switch adapted to be mounted on a circuit board, comprising:

- a housing, having:

- a first face, adapted to oppose the circuit board; and
- a second face, intersecting with the first face and formed with a projection;

- a cover, having:

- a first part, covering a side of the housing opposite to the first face;

- at least one second part, extending from the first part and opposing the second face; and

- a third part, extending from each of the at least one second part and engaging with the projection;

- an operating member, having a first part disposed outside the housing and adapted to be operated by a user, and a second part disposed in the housing;

- a movable contact, disposed in the housing and configured to be actuated by the second part of the operating member when the first part of the operating member is operated by the user; and

- fixed contacts, disposed in the housing and configured to be electrically connected with each other by way of the movable contact when the movable contact is actuated by the second part of the operating member,

- wherein the first part of the operating member has a portion opposing the second part of the cover, and is configured to abut against the second part of the cover so as to prevent the second part of the cover being deformed outward when the fixed contacts are electrically connected with each other.

5. The push switch as set forth in claim 4, wherein:

- the at least one second part includes a pair of second parts; and

- the second part of the operating member is located between the pair of second parts.

6. The push switch as set forth in claim 4, wherein:

- a thickness of the cover is no greater than 0.2 mm.

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